



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/662,709	09/15/2003	David J. Frank	YOR920030409US1(8728-645)	5879
46069	7590	09/08/2005		
F. CHAU & ASSOCIATES, LLC 130 WOODBURY ROAD WOODBURY, NY 11797			EXAMINER PERALTA, GINETTE	
			ART UNIT	PAPER NUMBER
			2814	
DATE MAILED: 09/08/2005				

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/662,709

Applicant(s)

FRANK ET AL.

Examiner

Ginette Peralta

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 April 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) 1-14 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 15-25 and 29-31 is/are rejected.
- 7) ☒ Claim(s) 26-28 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Claims 1-14 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected invention, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on 4/22/05.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 15, 16, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kozicki (U. S. Pat. 6,469,364 B1) in view of Rodgers et al. (U. S. Pat. 6,815,266 B2).

Regarding claim 15, Kozicki discloses in Fig. 1 and col. 2, lines 4-59 a method of forming a connection device that connects layers of integrated circuits that comprises forming a first dummy layer 14 over a first metal layer 12 (col. 5 lines 22,24); forming an actuating layer 12 over the first dummy layer 14 (col. 3, lines 3-7); forming a second dummy layer 14 over the actuating layer 12; forming a second metal layer 12 over the second dummy layer 14; and forming a plurality of vias 16 through the first dummy

layer 14, the actuating element 12, and the second dummy layer 14 and between the first metal layer 12 and the second metal layer 12.

Kozicki discloses the claimed invention with the exception of teaching that the vias are reconfigurable.

Rodgers et al. discloses in Figs. 3B to 3E and col. 3, line 14 to col. 14, line 14 a method of forming a connection device that connects layers of integrated circuits that comprises forming a first dummy layer 35 over a first metal layer 34; forming a reconfigurable via 39 through the first dummy layer and the first metal layer, wherein a reconfigurable via is formed between two layers of integrated circuits for the disclosed intended purpose of providing a connection that can be switched between numerous electrically detectable conditions of varying resistivity in nanosecond time periods that allow for a controlled electrical contact between two areas.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use re-configurable vias as the ones taught by Rodgers et al. in the invention of Kozicki for the disclosed intended purpose of providing a connection that can be switched between numerous electrically detectable conditions of varying resistivity in nanosecond time periods that allow for a controlled electrical contact between two areas and furthermore to improve conventional interconnection systems by providing an interconnection system that is easily alterable thus allowing an increased level of flexibility.

Regarding claim 16, Kozicki, as modified Rodgers et al., discloses in col. 1, lines 19-35 and col. 3, lines 64-67 of Rodgers et al. that the forming re-configurable vias comprises forming phase-change vias.

Regarding claim 18, Kozicki, as modified by Rodgers et al., discloses that the steps of forming a first dummy layer and a second dummy layer comprise forming a first dielectric layer 14 and a second dielectric layer 14 , respectively.

4. Claims 17, 19-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kozicki in view of Rodgers et al. as applied to claims 15, 16, and 18 above, and further in view of Gibson (US Pat. Pub. 2003/0081533 A1).

Regarding claims 17 and 25, Kozicki as modified by Rodgers et al. above discloses the claimed invention with the exception of the actuating layer comprising a resistive heating element.

Gibson discloses a method of forming a connection device that connects layers of integrated circuits that comprises using a resistive heating element as the actuator in a connection device that includes a phase-change layer, wherein the resistive heating element is used for the disclosed intended purpose of providing enough localized heating to aid the primary heat source resulting in the activation of the re-configurable regions of the device, as disclosed in ¶[0050].

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a resistive heating element as the actuating layer for the

disclosed intended purpose of providing enough localized heating to aid the primary heat source resulting in the activation of the re-configurable regions of the device.

Regarding claim 19, Kozicki, as modified by Rodgers et al., discloses that the step of forming re-configurable phase vias comprises forming a plurality of openings through the first dummy layer, the actuating layer and the second dummy layer and between the first metal layer and the second metal layer; and forming pillars 16,39 in each of the plurality of openings.

Regarding claim 20, Kozicki, as modified by Rodgers et al., discloses that the plurality of openings are formed by any well-known etching process, and self-assembly templating is a well known etching process.

Regarding claim 21, Kozicki, as modified by Rodgers et al. discloses that the step of forming the pillars in the openings comprises forming a phase change material layer 37 over the second dummy layer so as to fill the plurality of openings with phase-change material; and polishing the phase-change material layer to be flush with a top surface of the second dummy layer as disclosed by Rodgers et al. in col. 3, line 64 to col. 4, line 10.

Regarding claim 22, Kozicki discloses that the phase change material comprises germanium and tellurium among others. Gibson discloses that the phase change layer includes GeTeSb alloys among others, wherein GeSbTe is used for the disclosed intended purpose of using a material having a low transition temperature between the

first phase and the second phase, thereby lessening the power required to transform the material.

Regarding claim 23, Kozicki discloses that sacrificial electrodes are present along the pathways of the phase-change material, thus it would have been obvious to one of ordinary skill in the art at the time the invention was made to form spacers of the sacrificial metal before forming the phase change layer for the disclosed intended purpose of Kozicki of acting as a store of metal so that the connections are maintained when desired.

Regarding claim 24, Kozicki discloses in col. 2, line 6 to col. 3, line 11 and in Fig. 2 that electrical contacts 24, 26, 28, 30, and 32 are formed over the actuating layer; and providing a programming circuit that provides current to the actuating layer so that the re-configurable phase change vias change between a conductive state and a non-conductive state. Gibson discloses that the actuating layer may comprise a resistive heating element, as applied above. Thus Kozicki as modified by Gibson discloses forming electrical contacts over the resistive heating element for the disclosed intended purpose of connecting to a power supply, on-chip transistor or other suitable switching device.

Regarding claims 29 and 31, Kozicki discloses a method for programming a connecting device having a plurality of vias used to connect layers of an integrated circuit that comprises providing current to an element in which the plurality of vias are

embedded so that the interconnection system changes between a conductive state and a non-conductive state.

Kozicki discloses the claimed invention with the exception of the element being a resistive heating element and the vias being re-configurable.

Rodgers et al. discloses in Figs. 3B to 3E and col. 3, line 14 to col. 14, line 14 a method of forming a connection device that connects layers of integrated circuits that comprises forming a first dummy layer 35 over a first metal layer 34; forming a reconfigurable via 39 through the first dummy layer and the first metal layer, wherein a reconfigurable via is formed between two layers of integrated circuits for the disclosed intended purpose of providing a connection that can be switched between numerous electrically detectable conditions of varying resistivity in nanosecond time periods that allow for a controlled electrical contact between two areas.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use re-configurable vias as the ones taught by Rodgers et al. in the invention of Kozicki for the disclosed intended purpose of providing a connection that can be switched between numerous electrically detectable conditions of varying resistivity in nanosecond time periods that allow for a controlled electrical contact between two areas and furthermore to improve conventional interconnection systems by providing an interconnection system that is easily alterable thus allowing an increased level of flexibility.

Gibson discloses a method of forming a connection device that connects layers of integrated circuits that comprises using a resistive heating element as the actuator in a connection device that includes a phase-change layer, wherein the resistive heating element is used for the disclosed intended purpose of providing enough localized heating to aid the primary heat source resulting in the activation of the re-configurable regions of the device, as disclosed in ¶[0050].

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a resistive heating element as the element for the disclosed intended purpose of providing enough localized heating to aid the primary heat source resulting in the activation of the re-configurable regions of the device.

Regarding claim 30, Kozicki discloses in col. 2, line 6 to col. 3, line 11 and in Fig. 2 that electrical contacts 24, 26, 28, 30, and 32 are formed over the actuating layer; and providing a programming circuit that provides current to the actuating layer so that the re-configurable phase change vias change between a conductive state and a non-conductive state. Gibson discloses that the actuating layer may comprise a resistive heating element, as applied above. Thus Kozicki as modified by Gibson discloses forming electrical contacts over the resistive heating element for the disclosed intended purpose of connecting to a power supply, on-chip transistor or other suitable switching device.

Allowable Subject Matter

5. Claims 26-28 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The primary reason for the allowance of the claims is the inclusion of the feature of forming a connection device that connects layers of integrated circuits that comprises forming a first dummy layer over a first metal layer; forming an actuating layer over the first dummy layer; forming a second dummy layer over the actuating layer; forming a second metal layer over the second dummy layer; and forming a plurality of reconfigurable vias through the first dummy layer, the actuating element, and the second dummy layer and between the first metal layer and the second metal layer; removing the first dummy layer and the second dummy layer so as to form air gaps between the actuating layer and the first and second metal layers which is not anticipated nor rendered obvious over the prior art of record. The prior art of record teaches interconnection structures that include re-configurable vias as part of the interconnection, with a dielectric layer separating the levels of interconnect and the re-configurable vias in the dielectric layer, but does not teach removing the dielectric layers to form air gaps between the actuating layer and the first and second metal layers.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ginette Peralta whose telephone number is (571) 272-1713. The examiner can normally be reached on Monday to Friday 8:00 AM- 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

GP

Wael Fahmy
SPE 2814